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**Mapping and Quantifying Spruce Budworm Defoliation: Digital Remote Sensing Classification Techniques Applied to Airborne Multispectral Scanner Data**

Delineation of defoliated areas and estimation of levels of defoliation are important components of managing forests affected by the spruce budworm. The Petawawa National Forestry Institute (PNFI) has investigated methods of mapping and quantifying budworm defoliation using digital remote sensing techniques.

Methods aimed at detecting the total amount of defoliation (loss of foliage from current year and previous years) can be helpful in monitoring stand conditions, predicting mortality, and planning salvage logging operations, especially if implemented on a regular basis. Assessing the amount of current defoliation (current year's foliage) by identifying the reddish state commonly caused by budworm feeding (particularly during the sixth larval instar) will also aid in detecting new outbreaks, determining current distribution of the budworm, and managing control programs. Another study investigating the latter method is underway at PNFI with the collaboration of the Maritimes Forest Research Centre.

In the study described in this article, digital images were obtained by an airborne multispectral scanner (Daedalus 1260) mounted in a Falcon fan jet operated by the Canada Centre of Remote Sensing. Two budworm-affected test areas of fir-spruce, mixed, and hardwood stands on Cape Breton Island, Nova Scotia, were selected. These areas were overflown August 22, 1980, at altitudes of approximately 7600 m (25,000 ft) and 1800 m (5,900 ft.). Color-infrared, aerial photographs were acquired simultaneously with the digital data. A ground survey of the two test areas was also conducted. The Nova Scotia Department of Lands and Forests initiated the multispectral scanner project and provided additional ground data and assistance with the field work. Ground data and assistance throughout the study were provided by Philip Gimbarzevsky of the Pacific Forest Research Centre (formerly of PNFI).

A multispectral scanner (MSS) is an electronic and optical device that scans unit areas on the ground in different wavelengths and produces binary numbers, which are proportional to the intensity of light received (reflected) from each unit area. The wavelengths generally used are in the visible to near-infrared range. The binary numbers are recorded on a magnetic tape and later used by a computer to reconstruct the image. The unit area from which the light is received is called a pixel (picture element). The size of the area on the ground covered by a pixel can vary greatly, depending on the type of scanner and altitude of the aircraft. Generally the size can range from less than 1 by 1 m (3.2 by 3.2 ft) to 25 by 25 m (82 by 82 ft) or larger. The data for this study were obtained at resolutions of 19 m (62.3 ft) (low resolution) and 4.5 m (14.75 ft) (high resolution).

The scanner used recorded the intensity of radiation in eleven spectral channels: seven in the visible and ultraviolet part of the spectrum, three in the near-infrared, and one farther into the near-infrared (1.65 $\mu$m). Therefore each pixel had eleven intensity data values associated with it. In this study the two ultraviolet channels had high noise levels and were not used in subsequent analysis of the imagery.

The data were analyzed at PNFI with the Applied Resource Image Exploitation System (ARIES). ARIES is a multiprocessor computer with software designed for the analysis of LANDSAT satellite scenes and other digital remote sensing imagery. The system was developed for the Canadian Forestry Service by Dipix Ltd. of Ottawa, Ontario, and is commonly used for image display, enhancement, and classification. Other capabilities are geometric correction of LANDSAT satellite scenes to cartographic coordinates (UTM) or overlay of two satellite scenes, which permits use of satellite scenes of different dates to improve forest classifications or detect forest changes. Also, once an image is classified, the area in hectares of forest classes can easily be tabulated.

Two image classification techniques were investigated in this study: supervised and unsupervised classification. Both were based on the premise that (1) different defoliation levels have characteristic and different reflectances in at least one of the spectral channels detected by the scanner, and (2) the reflectance differences would result in different intensity levels being recorded by the scanner.

For the supervised classification, the image is displayed on a TV monitor and several areas (termed training areas) of a known defoliation level are graphically outlined. The mean intensity level of the pixels within the training areas, the standard deviation, and the covariance matrix are then calculated on the computer. This procedure is repeated for all the defoliation levels of interest. The relevant parts of the image are classified into defoliation levels by examining the intensity levels of each pixel of the image and deciding (using maximum likelihood decision rules) whether each pixel is sufficiently close to the characteristic values obtained for each defoliation level. The end product is a color-coded output image displaying the relevant pixels categorized by defoliation levels.

For the unsupervised classification technique, the computer automatically defines the important classes by constructing a histogram of the number of occurrences of each intensity level in the image. Where there are peaks in the number of occurrences, a distinct class is

created. Each pixel is then classified by the computer (in a similar manner to the supervised classification) as to which class it belongs. The operator decides whether the classes are related to defoliation levels and with what levels they are associated.

The objective of the study was to determine the levels of budworm defoliation that can be assessed from airborne multi-spectral scanner data using supervised and unsupervised classification techniques. Secondary objectives were to determine useful resolutions or flying altitudes for defoliation classification and the optimum spectral channels for assessing defoliation.

Supervised classification techniques are difficult to apply for a general survey of defoliation level for all forest stands because differences in reflectance caused by varying hardwood component and crown closure of stands often mask the differences due to defoliation levels. Therefore, only dense pure fir-spruce stands were classified. In an operational mode the level of defoliation of unclassified softwood areas would have to be inferred (if necessary) from nearby classified stands. A secondary general classification delineating areas of softwood regardless of defoliation could be incorporated at this stage.

Supervised classification of the low-resolution data (19-m [62.3-ft] resolution) was unsuccessful. The forest stands were too small to give good training areas (small stands are difficult to outline on the image and give poor intensity-level statistics). Good results were obtained by supervised classification of the 4.5-m (14.75-ft) resolution data. Four levels of defoliation were successfully classified: light (0-33 percent) defoliation, moderate (34-66 percent), severe (67-90 percent), and extreme (>90 percent). The defoliation levels of training areas and areas used to test the classification were determined by photo-interpretation of 1:12,000 color-infrared photography supported by ground data. An additional class of forest damage (wind blowdown) was also identified.

The best spectral channels for separating defoliation levels were a near-infrared channel (particularly channel 9; 0.77-0.90 $\mu$m) and a blue channel (channel 3; 0.45-0.50 $\mu$m). A good classification was obtained using channels 9,3, and 7 (0.63-0.70 $\mu$m). The four levels of defoliation were classified with an accuracy of approximately 25 percent. Confusion was generally between adjacent defoliation levels; for example, light versus moderate as opposed to light versus severe. There was no confusion between defoliation classes and other forest types although the blowdown class was occasionally and understandably confused with slash on cut areas. The defoliation level of small groups of softwoods in hardwood stands and in stands of low crown closure was also obtained at 4.5-m (14.75-ft) resolution.

Two broad levels of defoliation (light and heavy) were identified by unsupervised classification techniques on both the 19-m (62.3-ft) and 4.5-m (14.75-ft) resolution data.

The capabilities of airborne multispectral scanner technology were demonstrated by the study. Very good results were attained using supervised classification procedures on high-resolution data (4.5 m [14.75 ft]). If large stands of dense fir-spruce suitable for training areas are available, good results may also be expected from low-resolution data. Unsupervised classification techniques discriminated broad levels of defoliation and may be applicable in areas in which stands are small and supervised techniques are difficult. The techniques offer potential as a method of mapping and quantifying spruce budworm defoliation.

A technical paper describing this work is currently in press (D. G. Leckie and F. A. Gougeon. Assessment of spruce budworm defoliation using digital airborne MSS data, Proceedings Seventh Canadian Symposium on Remote Sensing, Winnipeg, Man., Sept. 1981) or is available from the authors.

*Donald G. Leckie* and
*Francois A. Gougeon* — Petawawa National
Forestry Institute
Canadian Forestry Service
Chalk River, Ontario

**Potential Use of Nematodes Against the Spruce Budworm**

The potential use of entomogenous nematodes as biological control agents in integrated pest management programs has been recognized for decades. In the last 5 years, interest in the use of the nematodes for insect control has increased.

In 1981, J. R. Finney and F. G. Bennett of Memorial University of Newfoundland and K. P. Lim of the Newfoundland Forest Research Centre conducted a laboratory experiment to determine the susceptibility of the spruce budworm to a nematode, *Heterorhabditis heliothidis*. The result showed that the nematode caused mortality of both larval and pupal stages of the spruce budworm. Under laboratory experimental conditions, with applications of 3 ml water containing 400 nemas/ml, the nematode killed the spruce budworm within 48 hours at 24°C and within 120 hours at 17°C.

Use of *H. heliothidis* in Australia in 1981 provided an economical and effective method for controlling black vine weevil on potted plants in greenhouses and nurseries. In recent laboratory tests in the Western United States, another nematode, *Neoaplectana carpocapsae,* caused 100-percent mortality of western spruce budworm larvae, although field trials of the technique were less successful.

The Canadian Forestry Service is sponsoring contract research with the Biology Department of Memorial University of Newfoundland to continue studies on the use of nematodes in biological control of the spruce budworm. This research is being conducted by Jean Finney and Gordon Bennett. The contract will involve research on production and storage of the nematode, susceptibility of various developmental stages of the

spruce budworm under laboratory and field conditions, development biology of the nematode in the spruce budworm, and its formulation for field trials.

Researchers from the Newfoundland Forest Research Centre will be involved in the field testing of this method.

*K. P. Lim* — Newfoundland Forest Research Centre
Canadian Forestry Service
St. John's, Newfoundland

**Status of Spruce Budworm Infestations in Newfoundland**

Egg-mass and overwintering larval surveys in 1981 forecasted that moderate to severe defoliation would occur on a total of 21 000 ha (51,900 acres) of forest this summer, distributed in six areas in western and central Newfoundland. Light defoliation was expected on 134 000 ha (331,120 acres).

Sampling for spruce budworm began in early June, and larval development was approximately 2 weeks later than last year. Weather conditions were wet and cold throughout most of June, and balsam fir development was ahead of insect development. However, warm, dry conditions prevailed in July, and larval development progressed rapidly. Moderate to severe defoliation occurred in several areas of western Newfoundland. In central and eastern Newfoundland, budworm numbers were low. The expected moderate and severe defoliation did not occur and only a few small, light infestations remained.

During the week of July 4-10, a moderate inflight of spruce budworm moths occurred throughout western and central Newfoundland. Pheromone traps showed adults from Port Aux Basques to Hawkes Bay and east to Tote Brook about 15 km (9 miles) south of Bishop's Falls on the Bay D'Espoir Highway. These moths were

**Schedule of Meetings of Professional Societies and Groups, 1982-1985**

| Group | Late 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|
| Entomological Society of America | | | | |
| National Meeting | Toronto, ON<br>Nov. 29-Dec. 3<br>(Joint with Entomol. Soc. Can.) | Detroit, MI<br>Nov. 27-Dec. 1 | San Antonio, TX<br>Dec. 9-13 | Hollywood, Fl<br>Dec. 8-12 |
| Eastern Branch | Hartford, CT<br>Sept. 29-Oct. 1 | New Castle, NH<br>Sept. 21-23 | Hershey Park, PA<br>Sept. 26-28 | Williamsburg, VA<br>Oct. 9-11 |
| North Central Branch | | St. Louis, MO<br>March 15-17 | Wichita, KS<br>March 26-29 | Lexington, KY<br>March 26-28 |
| Pacific Branch | | Spokane, WA<br>June 21-23 | Salt Lake City, UT<br>June 18-21 | |
| Entomological Society of Canada | Toronto, ON<br>Nov. 29-Dec. 3<br>(Joint with ESA) | | St. Andrews, NB<br>October | |
| Entomological Society of Quebec | St. Hyacinthe, PQ<br>Oct. 21-22 | | | |
| Entomological Society of Ontario | Toronto, ON<br>Nov. 29-Dec. 3<br>(Joint with ESA) | | | |
| Entomological Society of British Columbia | Victoria, BC<br>Sept. 23-24 | | | |
| Society of American Foresters | Cincinnati, OH<br>Sept, 19-22 | Portland, OR<br>Oct. 16-19 | Quebec, PQ<br>Aug. 5-9<br>(Joint with CIF) | |
| American Forestry Association | Cincinnati, OH<br>Oct. 10-13 | October | | |
| National Association of State Foresters | | | | |
| National Meeting | Sparks, NV<br>Sept, 26-30 | | | |
| Northeastern group | | October | | |
| Western group | | June | | |

believed to have been transported by air currents to the Island from mainland Canada. Spruce budworm on the Island during this period were in the fifth to sixth instar and prepupal stages.

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St. John's, Newfoundland

**FPMI Leads Efforts To Register New Formulations of Fenitrothion and Aminocarb**

To help the Province of New Brunswick provide an array of alternative formulations for the two prime chemicals used in budworm control, Forest Pest Management Institute (FPMI) of the Canadian Forestry Service is taking the lead in a vigorous program aimed at registering several new formulations by the spring of 1983. The program was prompted by the New Brunswick Health Department's inquiry into the possible link between budworm aerial spraying and Reye's syndrome. The report exonerated budworm spraying of any implication of causing Reye's syndrome but did recommend the withdrawal of some emulsifiers from current formulations. Alternative formulations were therefore required, to increase the options available.

George Green, Director of FPMI, in a report dated July 7, 1982, indicated the program was on target and, barring unforeseen circumstances, would be successful. The plan required considerable orchestration of a number of cooperators and facilitators. Forest Protection Limited, New Brunswick, provided the technical expertise and the spray aircraft and materials. The entire Federal and Provincial registration cooperators including Agriculture Canada; National Health and Welfare; Fisheries and Oceans; Environment Canada; the departments of Health, Environment, and National Resources of New Brunswick; private companies; and university departments all cooperated to expedite the research plans.

As a result of the enthusiastic response of the cooperators, it is likely that new formulations will be in place, registered, and ready for use before the next protection season. This should greatly ease the burden for those protecting the valuable New Brunswick forest resource. A comprehensive report on the program is planned for a later *Newsletter*.

**EPA To Reorganize Toxic Substances Office**

EPA's Office of Toxic Substances (OTS), under the direction of John Todhunter, assistant administrator for pesticides and toxic substances, is expected to undergo a major reorganization shortly and establish a new science staff that will report to the OTS director. This change will reportedly interject more science into the Toxic Substances Control Act (TSCA) decisionmaking process, which has been tagged a high priority by EPA Administrator Anne Gorsuch. The planned reorganization will also create a planning and evaluation staff and four new divisions: program management, risk control, risk assessment, and industrial information and reporting. The current OTS organization does not have a specific office and is divided into six divisions: health and environmental review, exposure evaluation, assessment, chemical control, economics and technology, and management and support.

According to documents obtained by *Inside EPA* explaining the reorganization, the science staff will "assure that scientific approaches and judgments are intellectually consistent throughout the office and from one chemical to the next." The planning and evaluation staff will formulate the OTS budget, oversee development and implementation of outside contracting activities, and review "OTS regulatory packages to assure compliance with OTS policies on reducing unnecessary burdens on industry and restricting industrial innovation."

EPA says the program management office will be responsible for "identifying emerging issues" and developing "new and more cost-effective ways to fulfill program mandates." The program management office will be divided into five programs: premanufacture notice (PMN) review, test rules and guidelines, new chemical regulations, specific chemical review, and chemical hazard identification.

Under the slated reorganization, the risk control division will evaluate economics, engineering, and chemistry of TSCA decisions. This division will support the program office by "developing generic and specific orders and notices to support rulemaking." This program will be comprised of four branches: chemical analysis and control technology, chemical economics, and a separate branch for both new and existing chemical options.

**Using the Millipore Filter To Assess B.t. Spray Deposit**

Success in applying *Bacillus thuringiensis* (B.t.) from the air depends on uniform deposition of bacterial colonies, and one popular way to check this involves the use of millipore filters. The filters are placed in the spray blocks before treatment begins, collected immediately after spraying, and then cultured in a laboratory until growing colonies of B.t. on the filter can be counted. The result is an estimate of the number of B.t. spores deposited per unit area.

Norm Dubois, a USDA Forest Service researcher at the Hamden, Connecticut, Forest Insect and Disease Laboratory, has prepared an excellent series of 35 mm color slides depicting the evaluation of B.t. deposit with millipore filters. He has also written a short descriptive caption to go along with each slide, explaining what is illustrated.

If any CANUSA cooperators believe this slide series would be interesting or useful, eastern Program Management will arrange to lend a set of slides, with captions, for short periods of time. Contact Dave Grimble, Applications Coordinator, at the Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008; (215) 461-3017 or FTS 489-3017.

**Summarizing Our Research on Utilization of Balsam Fir**

Steve Sinclair, formerly at the University of Minnesota and now with Virginia Tech (VPI&SU), continues to be one of CANUSA's most prolific technology transfer enthusiasts. The January 1982 issue of *Northern Logger and Timber Processor* carries an excellent review of Program-sponsored fir utilization research in the Lake States, written by Steve and Douglas Barnes and Bob Govett.

Sinclair and his colleagues have been examining the amount of defect and lumber yield recovery from fir that is dying or has been killed by spruce budworm in Wisconsin and Minnesota. Their preliminary studies indicate that both healthy and dead fir can be used for waferboard. The suitability of fir (healthy, 1-year-dead, and 2-years-dead) for pulp and paper by kraft and thermomechanical processes is under investigation.

Sinclair's group recognizes that economic constraints — chiefly the absence of a market — are hampering fir utilization in the Lake States. They plan to analyze the problem and construct economic decision models and management guidelines to enhance use of balsam fir in that area.

**Smirnoff Does It Again**

To his many other scientific and artistic accomplishments, Wladimir Smirnoff of the Laurentian Forest Research Centre has added a children's book, "A strange tale of pals, bugs and bacteria." The book explains the action and use of *Bacillus thuringiensis* (B.t.) in a captivating and nontechnical way and includes a multitude of other interesting natural history phenomena woven into a fast-moving story that will surely delight its young readers. Printed with a soft cover and staple binding through a grant from the Crop Protection Division of Sandoz, Inc., San Diego, California, the book is considerably enhanced by a dozen attractive color photos and several photos in black and white, including one of the author.

Wladimir and Sandoz are to be congratulated on this wonderful little 48-page book explaining how B.t. can be used to combat noxious insects. Copies are available in either French or English from the author: Dr. Wladimir A. Smirnoff, Laurentian Forest Research Centre, P.O. Box 3800 Ste. Foy, Que. GIV 4C7.

Wladimir also reports a successful summer research program with the newly developed B.t. "Futura" formulation. This product allows for excellent deposits at low emitted volumes. Wladimir's objectives were to improve deposit and reduce application costs. His preliminary results suggest that he has accomplished both. Thank you, Wladimir, for delaying your retirement 1 year in order to finish this important project.

**Eastern Management Manual Update.**

CANUSA-East plans to publish a users' manual of information relating to spruce budworm and management of spruce-fir forests in the Maritimes and Great Lakes regions. The text will appear as a USDA Agriculture Handbook, hopefully by the end of calendar 1983. It is aimed at a wide audience — forest landowners and managers, forest pest suppression specialists in both the United States and eastern Canada, and professional and subprofessional forestry workers.

Listed below are tentative chapter titles and names of American and Canadian cooperators who have agreed to write for the Program.

| Title | Authors |
|---|---|
| Introduction | Program Management |
| General Biology — SBW and Forest | Program Management |
| Detection | D. C. Allen and L. Dorais |
| Prevention — Silviculture | B. Blum and D. Maclean |
| Damage Assessment | J. Witter and D. Ostaff |
| Economics | L. Irland and K. Runyon |
| Control | |
| Microbial | J. Dimond and O. Morris |
| Chemical | P. Shea and C. Nigam |
| Environmental Impacts | J. Trial and P. Kingsbury |
| Integrated Pest Management | G. Simmons and W. Cuff |

Without doubt, *Newsletter* readers will be contacted by these authors over the next few months for research details and updates to make the management manual as timely as possible.

**Eastern Data Fact Sheets — the Total Inventory**

A list of the latest batch of CANUSA-East's Data Fact Sheets, sent June 1 to eastern cooperators, was published in the July 1982 issue of the *Newsletter*. Here is a complete list of all the sheets still available.

To get on the Broomall mailing list for future fact sheets or to request single copies of one or more titles from this list, write to CANUSA-East, Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008.

| Title | Date |
|---|---|
| Pheromone trap catches | April 1981 |
| Spruce-fir volume equations: useful tools for rough inventory and general management purposes | April 1981 |
| Light traps give early warning of budworm outbreaks | July 1981 |
| Insecticides for spruce budworm control in the U.S. | July 1981 |
| Harvesting methods to reduce wind damage in spruce-fir stands | July 1981 |
| Costs of spruce budworm suppression | July 1981 |
| Rating spruce-fir vulnerability for budworm in Minnesota | July 1981 |
| Determination of spruce budworm larval stage | July 1981 |
| B.t. protects new foliage | November 1981 |
| Lumber yields from healthy and dead balsam fir | November 1981 |
| 100-inch bolt quality of balsam fir | November 1981 |
| Fettes method: estimating balsam fir defoliation | February 1982 |
| Sexing spruce budworm pupae | February 1982 |
| Large capacity pitfall trap | February 1982 |
| Insecticides for spruce budworm control in Canada | February 1982 |
| Spruce budworm information retrieval | February 1982 |
| Estimating spruce budworm spray costs | May 1982 |
| Rating fir vulnerability to budworm attack in eastern Canada | May 1982 |
| Pole pruner sampling of budworm larvae: are baskets necessary? | May 1982 |
| Deposit assessment techniques for B.t. | May 1982 |
| Prediction of timing and amount of budworm-caused mortality in fir/spruce stands | May 1982 |

**In Memoriam**

The Wildlife-Wildlands Institute of Missoula, Montana, notified CANUSA of the death of one of the grand old men of forest entomology, Frank C. Craighead, Sr. He died May 14, 1982, in Naples, Florida, at the age of 92.

Craighead was a two-career scientist. With a Ph.D. from George Washington University, he joined the USDA Insect Investigation Bureau, rising to the position of Chief. He supervised the compilation of the classic *Insect Enemies of Eastern Forests* and coauthored *Larval Forms of the Order Coleoptera*. His 1925 article "Bark Beetle Epidemics and Rainfall Deficiency" (J. Econ. Entomol. 18:557-586) was one of the first to discuss tree stress as a factor in attack success of scolytids. In the 1930's he worked with R. A. St. George on systemic insecticides for insect control in trees, another new idea.

Craighead's second career, as a tropical plant ecologist, began when he retired to south Florida. He was interested in rapidly disappearing species of native plants, the ecological role of hurricanes, and the environmental problems associated with the area's water resources. Colleagues described his solo outings into the Everglades, with specimen jars and diet food for lunch. Three books came out of his Florida research — *Orchids and Other Air Plants of the Everglades National Park* and the two-volume *Trees of Florida,* all from the University of Miami Press.

His nearly 70 years in the field were studded with citations. In 1957, Penn State gave him their Forestry Achievement Award, and the U.S.Department of the Interior recognized him with their Conservation Award in 1969 and National Park Service Honorary Ranger Award in 1973. His adopted home, Collier County, Florida, created Frank Craighead Day on November 16, 1976.

**Supervisor of Insect Rearing at FPMI Receives Environment Canada Merit Award**

Dail Grisdale, supervisor of the Insect Rearing Section at the Forest Pest Management Institute (FPMI) in Sault Ste. Marie, Ontario, has received a Merit Award from Environment Canada for his outstanding contributions to the Canadian Forestry Service. The award was presented to Dail on July 16, 1982, by George Green, Director of FPMI, and carried with it a personal letter of commendation from the Deputy Minister, J.B. Seaborn, and a cheque for $1500.

As CANUSA cooperators, particularly those in the East, will know, the FPMI insect rearing section is the largest and most diversified of its kind in North America. It currently produces nearly 4 million spruce budworm larvae per year. Of these about 2 million are shipped to outside agencies for use in their research programs. The

remainder are used at the Institute for research and virus production. Sixteen other insect species are reared, two of which, the western spruce budworm (0.5 million) and the white-marked tussock moth (1.3 million) are used primarily for virus production. Those who use the output of this facility appreciate the flexibility and scope of research possible when large and continuous supplies of insects are available.

This high production capability has not always existed. In 1963, shortly after Dail assumed responsibility for the section, annual output totalled 39,000 insects in four species. From such modest beginnings, Dail has been able to increase production to meet the demands of an expanding and diversified Institute program and many outside cooperators. In this, he has been aided by a very able staff, particularly Arlene McMorran, who developed and modified the highly successful artificial diet. The Merit Award recognizes Dail's outstanding contribution to the Institute and the CFS. As Dail points out, the award is a tribute to the importance of insect rearing to progress in research of forest insect pests.

Congratulations, Dail!

**Personnel**

At the end of July, the backstage force behind the CANUSA *Spruce Budworms Bibliography* and Management Inventory, Mrs. Ruth Slusher of the Oak Ridge National Laboratory, retired after 35 years' service. Ruth's employer, Union Carbide, is reorganizing, and a number of people are being let go. Typical of her generosity was Ruth's offer to leave Carbide even though she was not targeted for the widespread layoffs, making room on the roster for a younger worker to stay on.

Ruth has helped Mel McKnight and the Orono bibliographic people throughout CANUSA by creating computer programming to store our data base and even to rearrange its fields into the format of the American National Standards Institute (ANSI), which suddenly became the Forest Service style after *Supplement 1*. Ruth has arranged for us to use a program that will generate camera-ready copy for the *Supplements* right on reproduction proof paper, so we can skip the typesetting phase altogether. *Supplement 1* appeared in good-quality typewriter type, but *Supplement 2* will be a text set in Times Roman instead of typewriter type. Because these programs will be used for other Forest Service bibliographic projects, Ruth's expertise will continue to help us long after she leaves the CANUSA family.

For some years now, Ruth has been building her mountain "dream house" in Tennessee. Because the property is many miles from firefighting help, Ruth decided to build the house in *stainless steel*. Despite this act of treachery, all of us at the USDA Forest Service wish Ruth the very best fortune in retirement and express again our thanks for her help over these many years.

**Items from the Press**

Budworm spray. — A task force report on health hazards resulting from New Brunswick's spruce budworm spray program should be ready for public presentation to the legislature's environment committee by the end of April, Natural Resources Minister J.W. Bird says.

Speaking to students at the University of New Brunswick yesterday, Mr. Bird defended the need to continue the spray program to protect the province's forests, but vowed if there is clear evidence of environmental or health dangers identified by the task force "I can tell you that the spray program will be stopped immediately."

He said it is expected this year to increase the acreage sprayed against the spruce budworm by about 25 per cent.

Last year, 1.8 million hectares (4.4 million acres) of forest land were sprayed at a total cost of $13 million.

This year, it is proposed 2.2 million hectares (5.4 million acres) and 121,405 hectares (300,000 acres) of private woodlot land are to be sprayed at a cost of between $16 and $17 million.

(Daily Gleaner — March 19, 1982)
Fredericton, New Brunswick

Objective: defeat the spruce budworm! — In the face of what some entomologists consider to be the last gasps of the spruce budworm, the Quebec government's insect control services are preparing to strike a powerful blow by increasing the spraying of insecticides this year. Thirteen million dollars will be spent on an area of 1,250,000 hectares, almost twice as large as last year.

At dawn and dusk during the last days of May, when the air is still calm, the humming of eight four-engine aircraft (DC-4s and Constellations) and of single-engined aircraft will be heard above the Quebec forests, especially in eastern Quebec and the Gaspe area.

These aircraft will be raining down Matacil, Fenitrothion and biological insecticides on the spruce budworm which has increased considerably in numbers in the east.

This spectacular increase in the spruce budworm population in eastern Quebec is probably its last gasp said Mr. Louis Dorias, chief of the control program for the entomology and pathology service.

(Le Soleil — 3 avril 1982)
Québec, Québec

Cape Breton salvage and storage program. — The four-year wood salvage and storage program in the Cape Breton Highlands has been completed on target.

From the spring of 1978 to the end of December, 1981, about 1.2 million cords of pulpwood were harvested from spruce budworm-damaged stands on the Highlands and of this, 500,000 cords were placed in storage at roadside.

Under normal conditions, about 360,000 cords would have been harvested on the Highlands.

(Forest Times — April 1982)
Truro, Nova Scotia

NDP: Spray program. — The spruce budworm spray used in New Brunswick should be banned until further tests on its safety are done, says Jim Fulton, New Democratic Party environment spokesman.

Fulton told the Commons recently a study done for Environment Minister John Roberts found that falsified information may have been used to obtain registration for the spray called fenitrothion.

He said the federal study urged that the spray be banned pending further tests, and also recommended that the Agriculture Department be stripped of its power to approve pesticides and that the task be given instead to a special commission.

Roberts and Health Minister Monique Begin rejected the demand for a ban on budworm spraying in New Brunswick saying there is no proof that fenitrothion causes cancer.

The New Brunswick government has permitted the aerial spraying of the province's forests for years in hopes of controlling the voracious spruce budworm, which attacks softwood trees and threatens the lumber and pulp and paper industries.

(Daily Gleaner — April 27, 1982)
Fredericton, New Brunswick

The spray program. — A nine-member task force, headed by Dr. Walter Spitzer of McGill University, has released its report on New Brunswick's budworm spray program. The scientists have determined that the spray program is safe in relation to Reye's syndrome. They further found that fenitrothion, the main spray ingredient, provides an acceptable margin of safety for people and the environment. However, they recommended that the emulsifier, Atlox 3409, should not be used, and that fenitrothion should be the only chemical insecticide used and that it should be diluted to its lowest effective rate.

(Daily Gleaner — April 30, 1982)
Fredericton, New Brunswick

Safety fear halts budworm spraying. — New Brunswick's much-maligned spruce budworm spray program has encountered another roadblock, but this time a chemical company, not an environmental group, is waving the red flag.

Aircraft were scheduled to begin spraying Wednesday morning, but Natural Resources Minister J.W. Bird grounded them at the last minute because of concerns raised by Dow Chemical Canada Inc., the manufacturer of an important chemical in the spray formula.

Bird told the legislature Wednesday the spray program's first phase, which would cover 500,000 acres of woodland close to human habitation, is being delayed because Dow Chemical is not sure its product Dowanol is safe to use in large concentrations.

The federal Departments of Agriculture and Health and Welfare have approved the use of Dowanol as a solvent in combination with the insecticide fenitrothion.

But Bird said Dow Chemical notified him by telegram last Friday that the company has not tested Dowanol in the strength in which it's being mixed for the New Brunswick spray program.

Bird said that while the provincial government is confident about the safety of Dowanol, it did "not want to be caught in the middle of a controversy between the manufacturer and federal registration authorities by using a product in what is already a very controversial and sensitive government forest-protection program."

Bird told reporters outside the legislature the delay in this year's spray program is only temporary.

(The Citizen — May 27, 1982)
Ottawa, Ontario

**Recent Publications**

From the Northeastern Area, State and Private Forestry, 370 Reed Road, Broomall, PA 19008, you may request

Ford, R. P. 1981. "Evaluation of a method to determine spruce-fir mortality caused by the spruce budworm in the Lake States." 74 p.

Rush, P. A., R. P. Ford, A. S. Munson, and C. F. Croghan. 1982. "Release of DIPEL 4L for control of spruce budworm (on the) Nicolet National Forest, 1981: A post suppression evaluation." Admin. Rep. 82-3. 7 p.

The Northeastern Forest Experiment Station, at the same Broomall address, offers

Seegrist, D. W., and S. L. Arner. 1982. "Mortality of spruce-fir in Maine in 1976-78 due to the spruce budworm outbreak." Res. Pap. NE-491. 3 p.

John Witter's grad student teams have assembled several publications of interest to researchers working in the Lake States. Request copies from Witter at the School of Natural Resources, University of Michigan, Ann Arbor, MI 48109.

Lynch, A. M., I. P. Mog, and J. A. Witter. 1982. "Impact of the spruce budworm on the Sault Ste. Marie and St. Ignaca Districts of the Hiawatha National Forest, 1978-81." Tech. Rep. 82-2. 24 p.

Lynch, A. M., I. P. Mog, and J. A. Witter. 1982. "Impact of the spruce budworm on the Munising, Rapid River and Manastique Districts of the Hiawatha National Forest, 1978-81." Tech. Rep. 82-3. 25 p.

Montgomery, B.A., G.A. Simmons, and J.A. Witter. 1981. "The spruce budworm manual for technology transfer specialists in the Lake States — Preliminary Version." Tech. Rep. 81-4. 87 p. + appendix.

Waisanen, L. 1982. "Applying the negative binomial distribution to spruce budworm egg mass sampling for damage prediction in balsam fir stands in the Upper Peninsula of Michigan." Info. Rep. 82-1. (Master's thesis.) 51 p.

Forest Pest Management, State and Private Forestry, Southwestern Region, 517 Gold Avenue, S.W., Albuquerque, NM 87102, will supply

Rogers, T. J., and N. William Wulf. 1982. "Western spruce budworm silvicultural demonstration area project, Carson National Forest." Rep. 2. 13 p.

From the Intermountain Forest and Range Experiment Station, 507 25th Street, Ogden, UT 84401, you may order

Carlson, Clinton E., and Ward W. McCaughey. 1982. "Indexing western spruce budworm activity through radial increment analysis." Res. Pap. INT-291. 11p.

The State of Maine announces the publication of "Fate of carbaryl in Maine spruce-fir forests (a literature review)" by Harry W. Trask. You may request a copy from the Bureau of Forestry, State Office Building, Augusta, ME 04333.

From the Department of Fisheries and Oceans, 8th Floor West, 240 Sparks Street, Ottawa, Ont. K1A 0E6, you may request a copy of

Weinberger, P., and M. Rea. 1981. "Nonylphenol: a perturbent additive to an aquatic ecosystem." *In* N. Birmingham, C. Blaise, P. Coutre, B. Hummel, G. Joubert, and M. Speyer, eds. Proceedings Seventh Annual Aquatic Toxicology Workshop, Nov. 5-7, 1980. Montreal. Can. Tech. Rep. Fish Aquatic Sci. 990. 519 p.

Wildish, D. J., and J. K. Elner. "Absence of long-term changes in the microbiology of freshwater ponds treated with Matacil." Can. Tech. Rep. Fish. Aquatic Sci. 1049. 17 p.

The Great Lakes Forest Research Centre, Box 490, Sault Ste. Marie, Ont. P6A 5M7 has released Information Report O-X-336 by G. M. Howse, A. A. Harnden, J. A. Meating, and J. R. Carrow entitled "The 1980 spruce budworm situation in Ontario. Part A: Damage and forecasts. Part B: Aerial spraying operations."

Two reports from the Pacific Forest Research Centre, 506 West Burnside Road, Victoria, B.C. V8Z 1M5, may be of interest to budworm scientists

Fiddick, R. L. and G. A. Van Sickle. 1981. "Forest Insect and Disease Conditions in British Columbia and Yukon/1981." Information Report BC-X 225.

Ruth, D. S., G. E. Miller, and J. R. Sutherland. 1981. "A guide to common insect pest and diseases in spruce seed orchards in British Columbia." Information Report BC-X-231.

The Quebec Forest Research Service announces the publication of the following series related to the spruce budworm problems in Quebec. These publications are presently published in French and are available from the Ministère des Terres et Forêts, Complexe Scientifique, 2700 rue Einstein, Ste-Foy, Qué. GIP 3W8.

Tome I — "Impacts bio-physiques et économiques sur un cas-type (Haute et Basse Gatineau)." Mémoire nº 67 par le Comité de coordination des recherches sur l'économique de la tordeuse, 1980.

Tome II — "L'aménagement des peuplements susceptibles." Mémoire nº 71 par Germain Paré et Henriel Poulin.

Tome III — "La conversion des peuplements les plus susceptibles." Mémoire nº 73 par Germain Paré et Henriel Poulin.

Tome IV — "La compensation des pertes par l'aménagement intensif des peuplements non susceptibles." Mémoire nº 74 par Henriel Poulin, Germain Paré et Dominic Ménard.

Tome V — "La récupération des bois attaqués." Mémoire nº 77 par Henriel Poulin et Germain Paré.

Tome VI — "Document-synthèse." Mémoire nº 78 par Henriel Poulin et Germain Paré.

## In the Hopper

As the Program swings into its last year, we want to highlight the new publications that have been received in the Washington Office for printing as USDA series handbooks. At this stage, the manuscripts have been edited in the field and reviewed by peer scientists. In the next step, I check over the complete package (text and artwork), route the manuscript through the Forest Service Washington Office staffs for official approval and final suggestions, and submit the whole package to our Office of Information (OI).

The OI people secure departmental approval to publish, send the text out for typesetting, and contract for any needed layout or design work on the final text and art. Through the U.S. Government Printing Office (GPO), typesetting and printing contracts are let, a process that takes at least a month. Eventually, galley proofs will arrive back at my office, where I will check the proof and consult with the senior author if there are new problems.

In the next step, a designer lays out "boards" or "flats" of the text and blank spaces for the artwork. The boards are then photographed at the printer's and a color proof is pulled for checking. The OI printing specialists go over the proof with me, marking it up for color correction if necessary.

Finally, after making specified corrections on the press, the printer begins the press run. Our printing specialists attend press inspections, to be sure we have good quality control when the printing actually takes place.

When this issue of the *Newsletter* was being put together (July 1982), we had received our second anticipated USDA series handbook: Dave Grimble and Ozzie Morris's brochure on the operational use of B.t. in Maine and Canada. (The first publication in the hopper was Crawford and Jennings' long-awaited "birds and budworms" bibliography, scheduled to appear this fall as Bibliographies and Literature of Agriculture No. 23)

In the upcoming months, we expect to receive 31 such manuscripts, including the large management manuals from CANUSA-West and -East. As the titles reach Washington, they will be announced in this box in the *Newsletter*.

*Janet Searcy* — Information Coordinator
CANUSA Program,
Washington, DC

## CANUSA Extended in the United States

Unlike Pinnochio's nose, which grew longer with every lie, the CANUSA Program gets longer when we tell the truth. During the past year U.S. Program Management has been making a case for extending accelerated funding beyond September 30, 1983, our scheduled termination date. We needed the extra time to complete our documentation of research results.

We were happy to learn that the Program has been given another year (U.S. Fiscal Year 1984, ending September 30, 1984) to achieve its goals for technology transfer. The announcement was made by USDA Forest Service Deputy Chief for Research Bob Buckman at the annual meeting of the Joint Policy and Program Council.

During the extension year, the U.S. side will be printing its 33 USDA series publications and staging a variety of workshops in both East and West, to familiarize land managers with the results of CANUSA-sponsored research. No new research projects will be funded during FY 1984, but we expect to spend some money on applications-oriented projects.

Finding extra money in the American Federal budget is no easy task right now, and CANUSA cooperators on both sides of the border join in thanking Dr. Buckman for his efforts on our behalf.

For more information or if you wish to have your name added to the mailing list for the *Newsletter,* contact:

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